UNIT-III Design of Fasteners and welded Joints

Session -1

**Objective:**  To introduce the joints and its types.

https://atecentral.net/g18237‎

**Recap**: Recall the Fundamentals of coupling design particularly in bolt design with suitable formula

**SCREWED FASTENER**

A screw thread is obtained by cutting a continuous helical groove on a cylindrical surface (external thread). The threaded portion engages with corresponding threaded hole (internal thread) forming screwed fastener. Screwed fasteners such as bolts, studs and nuts in combination, machine screws are used for fastening components that require frequent assembly and disassembly. Screwed fasteners are to hold parts together and to transmit power.

**1. Major diameter**

This is the largest diameter of a screw thread, touching the crests on external thread or the roots on internal thread. This is also called nominal diameter.

**2. Minor diameter**

This is the smallest diameter of a screw thread, touching the roots or core of external thread or the crests of internal thread. This is also called core or root diameter.

**3. Pitch diameter**

This is the diameter of an imaginary cylinder, passing through the threads at the points where the width of thread is equal to the space between threads.

**4. Pitch**

It is the distance measured parallel to the axis, between corresponding points on adjacent screw threads.

**5. Lead**

It is the distance, a screw advances axially in one turn. For a single threaded screw, the pitch and lead are equal. For a double threaded screw the lead is twice the pitch and so on.

**FORMS OF THREADS**

Bureau of Indian Standards (BIS) adopts ISO (International Organization for Standards) metric threads which are followed by number of countries.

**1. V-Thread**

This thread profile has a larger contact area providing more frictional resistance to motion. It is used where effective positioning is required.

**2. British Standard Whitworth (B.S.W) thread**

This thread is adopted in Britain in inch units. The profile has rounded ends making it less liable to damage than sharp V-threads.

**3. Square thread**

This is an ideal thread form for power transmission. In this as the threaded flank is at right angle to the axis. The normal force between the threads acts parallel to the axis with zero radial components. This enables the nut to transmit very high pressure as in case of a screw jack and other similar applications.

**4. Buttress thread**

This thread form is combination of V-thread and square thread. It exhibits the advantages of square threads like the ability to transmit power and low frictional resistance and the strength of a V-thread. It is used where power transmission takes place in one direction only.

**5. ACME thread**

It is a modification form of square thread. It is much stronger than square thread because of the wider base and it is easy to cut. The inclined sides of thread facilitate quick and easy engagement and disengagement as for example the split nut with the lead screw of lathe.

**Conclusion &Summary:** Recall the basics of thread parameters

Session -2

**Objective:** To design the threaded bolts under axial load.

web.itu.edu.tr/temizv/VTDN/6\_**Screws**.pdf‎‎

**Recap:** Recall the basics of thread parameters

 **PPT and Board Explanation**

**STRESSES DUE TO EXTERNAL FORCES:**

Bolts, studs and screws are subjected to tensile stresses by the external forces acting on them, but occasionally the bolts are subjected to shear loads also, the common example being the bolts of the flange coupling. When a bolt is subjected to an axial tensile load, the weakest section will be at the root of the thread. If d be the diameter at the root of the thread, then



**DESIGN OF BOLTS FOR EASY SITUATION**



**Conclusion &Summary:** Conclude the session by recalling the various stresses induced on threads

Session -3

**Objective:** To design bolts under eccentric load condition

nptel.iitm.ac.in/courses/Webcourse-contents/.../Module-4\_lesson-4.pdf‎

**Recap**: Recall the Fundamentals of bolts design

 Recalling the fundamentals by asking

 What is core dia?

 From the given load condition and torque calculate the core dia of bolt

**ECCENTRICALLY LOADED BOLTED JOINTS PPT and Board Explanation**

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Taking moments about 0,

 

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It can be seen from the above that bolts in the second two stresses due to F and F are, are put into higher stress.



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**Conclusion &Summary:** Recall formula for eccentric load condition.

Session -4

**Objective:** To solve simple problems blot design

**Recap:** Recall what is screw, what are all the types, design procedure and methods.

Tutorial Problem: **Board Presentation**

 From university question bank solve simple problems on bolt design under axial load condition.

**Conclusion &Summary:** Conclude the session by recalling the various steps involved in bolt design

Session -5

**Objective:** To simple problems on bolts design

Recap:Recallsteps involved in bolt design

Problem.

The cylinder head of a steam engine with 250mm bore is fastened by eight stud bolts made of 30C8 steel Maximum pressure inside the cylinder is 1 Mpa. Determine the bolt size and approximate tightening torque. Take 20% overload. Assume 􀄱 = 300Mpa for bolt material **Board Presentation**

**Given data:**

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**To find:**

1. Bolt size
2. Tightening torque
3. Total load on the head(With 20% overload)

Solution:

Total load on the head (with 20% over load)

 

This is shared by 8 bolts.

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**Conclusion &Summary**: Recall the session by summarizing the concepts of coupling and its function with types

Session -6

**Objective:** To develop the design procedure on riveted joints

www.stat.columbia.edu/~regina/research/slides5.pdf‎

Recap:Recall

 **Board Presentation**

**RIVETED JOINTS**

A rivet is a round bar provided with a head on one side and a tail on t other side as shown in fig. various parts of the rivet also described in this fig

It is general made of mild Steel or iron. Sometimes it may be made of copper and Aluminum where the corrosion Resistance and lightweight .The material used should be strong and ductile.

Riveted joints arc used for connecting two parts in high strength necessary in structural connections, strength and rigidity are required Pressure vessel work. Strength. Rigidity and leakage are the essentialities of the joint. It is also used for general-purpose: turbines break bands etc.

 

**EFFICIENCY OF A RIVETED JOINT:**

The efficiency of a riveted joint is defined, as the ratio of strength of the joint at the weakest made of failure to the strength of un punched plate in one pitch length of the joint.





According to I. B. R. the thickness of cover plate (ti) butt joint is as

Follows. 

row having alternate rivets.



for double cover with the outer most row having alternate rivets.

For unequal width of cover plates:



**Conclusion &Summary:** Recall procedure for designing riveted joints

Session -7

**Objective:** To design welded joints under axial load condition

www.ignou.ac.in/upload/Unit-4-60.pdf‎

**Recap**: Recall the Fundamentals of welding and the types joints

**INTRODUCTION PPT and Board Explanation**

Welding is the most commonly used process for permanently joining machine parts. Welding is done by fusing the metallic parts with heat at their junction with or without pressure.

**Advantages of welding over riveting**

* Possibility of joining curvilinear parts
* Cost is less
* Tightness of joint
* Noiseless process
* Greater strength

**DESIGN OF WELDED JOINTS**

In order to determine the strength of fillet joint, it is assumed that the section of fillet is a right angle triangle ABC with hypotenuse AC making equal angles with other two sides AB and BC. The length of each side is known as leg or size of the weld and the perpendicular distance of

hypo tenuous from intersection of legs (BD) is known as the throat thickness.

*BD*  sin 

*AB*

In the triangle BDA



*BD*  *AB* sin 

=s sin45=0.707s

**STRENGTH OF TRANSVERSE FILLET WELDED JOINT**

The fillet or lap joint is obtained by overlapping the plates and then welding the edges of the plates. The transverse fillet welds are designed for tensile strength.



Assumed that the weld section is right angle triangle ABC with hypotenuse AC making equal with other two sides AB and BC

t- throat thickness

s- thickness of plate l-length of weld throat thickness

t=s\*sin45=0.707s

minimum aera of the weld

A=t\*l=0.707s\*l

σt is the allowable tensile stress for the weld then tensile strength of joint for single fillet weld

*P*  0.707*s*  *l*   *t*

Tensile strength of joint for double fillet weld

*P*  2  0.707*s*  *l*   *t*

**STRENGTH OF PARALLEL FILLET WELD**

The parallel filet weld joints are designed for shear strength. Consider a double parallel fillet weld as shown in figure



Shear strength of joint due to double parallel fillet weld

*P*  2  0.707*s*  *l* 

 1.414  *s*  *l* 

Combination of single transverse and double parallel fillet weld then the strength of joint

*P*  0.707*s*  *l*1   *t*  1.414  *s*  *l*2 

**Conclusion &Summary:** Recall formula for Axially load condition with PSG data book.

Session -8

**Objective:** To solve simple problems weld design

**Recap:** Recall thickness of weld, what are all the types, design procedure and methods.

Tutorial Problem: **Board Presentation**

 From university question bank solve simple problems on weld design under axial load condition.

**Conclusion &Summary:** Conclude the session by recalling the various steps involved in weld design

Session -9

**Objective:** To design Unsymmetrical welded joints under axial load condition

www.roymech.co.uk/Useful\_Tables/Rivets.html

**Recap**: Recall the Fundamentals of welding and the types joints

**AXIALLY LOADED UNSYMMETRICAL WELD SECTIONS**

 **PPT and Board Explanation**

Unsymmetrical sections such as angles, channels T-sections etc, welded on the flange edges are loaded axially as shown in figure. In such case the length of weld should be proportioned in such a way that the sum of resisting moments of the welds about the gravity axis is zero.

la- length of weld at the top

lb- length of weld at the bottom l- total length of weld

a- distance of top weld from gravity axis

b- distance of bottom weld from gravity axis

*la* 

*l* 

*b*

*a*  *b*

, *lb*

 *l*  *a a* 

*l*  *la*  *lb*

Solve simple problems on unsymmetrical welded Joints

**Conclusion &Summary:** Recall unsymmetrical weld jointsformula for axially load condition with PSG data book.

Session -10

**Objective:** To design welded joints under eccentric load condition.

www.ignou.ac.in/upload/Unit-4-60.pdf‎

**Recap:** Recall what is thickness of weld, what are all the types, design procedure and methods.

**ECCENTRICALLY LOADED WELD JOINTS**  PPT&**Board Presentation**

When a welded joint is eccentrically loaded the principle stress will be applied because the welded part undergoing direct load and a bending moment when a welded joint is loaded eccentrically as shown in figure subjected to two types of stresses

1. Direct or primary shear stress

2. Shear stress due to turning moment



P- Eccentric load

e- Eccentricity (i.e.) perpendicular distance between the line of action of load and center of gravity(G) of throat section

l- length of single weld t- throat thickness

Direct or primary shear stress

 1 

*P*

1.414  *s*  *l*

Shear stress due to turning moment (i.e.) secondary shear stress

  *P*  *e*  *r*2

1 *J*

The polar moment of inertia of the throat area (A) about the center of gravity (G) is obtained by the parallel axis theorem

x- perpendicular distance between two parallel axis

 *l* 

*J*  2 *A* 2  *x* 2 

 12 

*A*  0.707  *s*  *l*

Resultant shear stress at A

 *A* 



1

2

2   2

  1   2  cos  

θ-angle between τ1 and τ2

cos   *r*1

*r*2

**Conclusion &Summary:** Recall welded jointsdesign for eccentric load condition with PSG data book.

Session -11

**Objective:** To design Knuckle joints.

**Recap:** Recall what is thickness of weld, what are all the types, design procedure and methods.

**KNUCKLE JOINT**

A knuckle joint is used to connect two rods which are under the action of tensile loads. It consists of mainly three elements a fork or double eye rod, a single eye rod and knuckle pin. Its use may be found in the link of a cycle chain, tie rod joint for roof truss.



Dimension of various parts of the knuckle joint d- diameter of rod

d1- diameter of pin outer dia of eye

d2=2d diameter of knukle pin head and coller

d3=1.5d thickness of single eye or rod end

t=1.25d thickness of fork

t1=0.75dthickness of pin head

t2=0.5d

**Conclusion &Summary:** Recall Knuckle joints and its applications.

Session -12

**Objective:** To solve simple problems weld design and knuckle joints

**Recap:** Recall the concepts of weld design with eccentric load

Tutorial Problem: **Board Presentation**

From university question bank solve simple problems on weld design under eccentric load condition.

**Conclusion &Summary:** Conclude the session by recalling the various steps involved in weld design